

## 1.2. BARROW OBSERVATORY

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### 1.2.1. OPERATIONS

It was a relatively quiet year for CMDL programs at the BRW Observatory during 1993. Cooperative programs experienced some minor changes with the addition of new programs and changes in continuing programs. Barrow continues to serve as a training center for SPO personnel. This year the NOAA Corps officer was in Barrow for training during May and June. The SPO technician was in SMO for training because of scheduling conflicts.

The biggest problem during the winter months involved access to the station. Once the road drifted over with snow, it received no maintenance due to the high cost of snow removal. Access was accomplished by snowmachine, skiing, or walking. There were fewer polar bear sightings this year than last. During the summer months, a gate was installed across the road to keep the amount of local traffic to a minimum.

Plans for a new observatory building were completed during 1992 and are on site. NOAA facilities funding has not yet been secured for construction.

Both GSA vehicles continued to run well. An agreement with the DEW Line allows us use of one stall in the garage to park vehicles. The stall is used for the truck during the day and snowmachines overnight. The Skandic snow machine had the engine rebuilt after it blew a piston.

Water pipes in the bathroom at the house froze and had to be repaired this year. All the plumbing was moved so that all the pipes are now inside the house or in heated channels and no further freeze-ups are expected. In December the NWS hired a Seattle contractor to hook up the NOAA housing compound to the local utility system. The plans called for several hundred meters of unheated pipe with 10 mm of insulation to be installed and water to be circulated through it. The pipe froze two times in the first 24 hours and was disconnected. Future plans call for an upgrade sometime in 1995.

A tape back-up was installed in the station computer to save on the number of disks used in backing up the hard drive. A storm with westerly winds caused several power outages during the fall. It was an unusual storm with wet, heavy snow.

During 1993, BRW was visited by 88 registered guests. This list included guided tours, researchers, and interested individuals. Visitors from Japan, Russia, Canada, and the South Pole were all involved in research at BRW. U.S. Government agencies were represented by NOAA/NOS, the USGS, Army Corps of Engineers, ONR, the Navy, and the Air Force. Personnel from eight universities were involved in research as well. Twenty-five states were represented.

### 1.2.2. CMDL PROGRAMS

Table 1.4 summarizes the 1993 measurement programs at BRW. Operational highlights are as follows:

#### *Aerosols*

The TSI CNC continues to measure higher levels of condensation nuclei than the Pollak. The reason for the difference is still under investigation. Because of this difference,

independent data sets are maintained for both instruments. Both instruments ran all year with no major problems.

Backscatter, as measured by the nephelometer, continues to show the seasonal trends associated with arctic haze. Springtime highs and summer lows characterize the BRW data. Intermittent problems with the nephelometer were solved during the first quarter of the year by replacing all I.C. chips on board 7.

The aethalometer data acquisition system clock began to lose time early this year and a replacement laptop computer was ordered. Time loss of up to 20 seconds per day was noted. The laptop computer was replaced and a newer version of the software was installed.

A new data logging system was installed for the solar radiation program with aerosols sharing the hardware. For more detail see the Solar Radiation section.

#### *Solar Radiation*

The BRW Observatory solar program consists of a downward facing albedo rack approximately 75 m behind the station and 1.75 m above the surface with a quartz pyranometer and a pyrgeometer. An upward facing quartz pyranometer, an RG8 pyranometer, and a tracking NIP are mounted on the Observatory roof. Located in the Dobson dome is a filter wheel NIP with Quartz, OG1, RG2, and RG8 filters. Observations begin in January when the sun returns and cease when the sun sets in November.

The tracking NIP was installed in February and collected data until the end of the solar season with only minor problems. Most of the problems were caused by corrosion in the cable because of the salt air. The clutch in the tracker was repaired when it was found to be loose and causing tracking errors.

The biggest change in the solar program was the installation of a Campbell Scientific Instruments (CSI) data collection system. A comparison between the CSI and the CAMS was performed for a month, with favorable results, and the CAMS was retired. Data from the CSI can be accessed by field personnel and a higher level of data quality can be assured.

Apply blowers were installed on the roof PSPs to assist in keeping snow and ice from collecting on the domes. The new blower system works well and has reduced the maintenance needed to keep the domes ice free.

#### *Carbon Cycle*

**CO<sub>2</sub> NDIR.** CO<sub>2</sub> mixing ratios for the BRW Observatory show the same temporal distribution as in previous years. Winter highs of 360 ppm are seen with summertime lows of 345 ppm. A Siemens Ultramat 5E continues to be the station instrument and responds well to changes in atmospheric CO<sub>2</sub>.

During early March a power outage damaged the analyzer, and it was returned to Boulder for repairs. It was returned to BRW and put back into operation by the end of March.

During July the drive assembly for the Linseis recorder began sticking at lower voltage levels. The necessary parts were ordered, but before they arrived the chart recorder failed completely. The recorder unit was repaired and placed back in operation by the end of August.

TABLE 1.4. Summary of Measurement Programs at BRW in 1993

Program	Instrument	Sampling Frequency
<i>Gases</i>		
CO <sub>2</sub>	Siemens Ultramat 5E analyzer	Continuous
	3-L glass flasks	1 pair wk <sup>-1</sup>
	0.5-L glass flasks, through analyzer	1 pair wk <sup>-1</sup>
CO <sub>2</sub> , CH <sub>4</sub> , CO	0.5-L glass flasks, P <sup>3</sup> pump unit	1 pair wk <sup>-1</sup>
CH <sub>4</sub>	Carle automated GC	1 sample (12 min) <sup>-1</sup>
Surface O <sub>3</sub>	Dasibi ozone meter	Continuous
Total O <sub>3</sub>	Dobson spectrophotometer no. 91	3 day <sup>-1</sup>
N <sub>2</sub> O, CFC-11, CFC-12, CFC-113, CH <sub>3</sub> CCl <sub>3</sub> , CCl <sub>4</sub>	300-mL stainless steel flasks	1 sample wk <sup>-1</sup>
N <sub>2</sub> O, CFC-11, CFC-12, CFC-113, CH <sub>3</sub> CCl <sub>3</sub> , CCl <sub>4</sub> , HCFC-22, HCFC-141b, HCFC-142b, CH <sub>3</sub> Br, CH <sub>3</sub> Cl, CH <sub>2</sub> Cl <sub>2</sub> , CHCl <sub>3</sub> , C <sub>2</sub> HCl <sub>3</sub> , C <sub>2</sub> Cl <sub>4</sub> , H-1301, H-1211	850-mL stainless steel flasks	1 sample mo <sup>-1</sup>
CFC-11, CFC-12, CFC-113, N <sub>2</sub> O CCl <sub>4</sub> , CH <sub>3</sub> CCl <sub>3</sub>	HP5890 automated GC	1 sample h <sup>-1</sup>
N <sub>2</sub> O	Shimadzu automated GC	1 sample h <sup>-1</sup>
CO	Trace Analytical GC	1 sample (6 min) <sup>-1</sup>
<i>Aerosols</i>		
Condensation nuclei	Pollak CNC	1 day <sup>-1</sup>
	T.S.I. CNC	Continuous
Optical properties	Four-wavelength nephelometer	Continuous
Black carbon	Aethalometer	Continuous
<i>Solar Radiation</i>		
Global irradiance	Eppley pyranometers with Q and RG8 filters	Continuous
Direct irradiance	Tracking NIP	Continuous
	Eppley pyrhelimeter with Q, OG1 RG2, and RG8 filters	Discrete
Albedo	Eppley pyranometer	Continuous
<i>Terrestrial (IR) Radiation</i>		
Upwelling and downwelling	Eppley pyrgeometers	Continuous
<i>Meteorology</i>		
Air temperature	Thermistor, 2 levels	Continuous
	Max.-min. thermometers	1 day <sup>-1</sup>
Dewpoint temperature	Dewpoint hygrometer	Continuous
Pressure	Capacitance transducer	Continuous
	Mercurial barometer	Discrete
Wind (speed and direction)	Bendix Aerovane	Continuous
Precipitation	Rain gauge, tipping bucket	
<i>Cooperative Programs</i>		
Total surface particulates (DOE)	High-volume sampler (1 filter wk <sup>-1</sup> )	Continuous
Precipitation gauge (USDA)	Nipher shield, Alter shield, 2 buckets	1 mo <sup>-1</sup>
Magnetic fields (USGS)	3-Component fluxgate magnetometer and total field proton magnetometer	Continuous
	Declination/inclination magnetometer sample	6 sets mo <sup>-1</sup>
Various trace gases (OGIST)	Stainless steel flasks	1 set wk <sup>-1</sup> (3 flasks set <sup>-1</sup> )
CO <sub>2</sub> , <sup>13</sup> C, N <sub>2</sub> O (SIO)	5-L evacuated glass flasks	1 pair wk <sup>-1</sup>
CH <sub>4</sub> (Univ. of Calif., Irvine)	Various stainless steel flasks	1 set (3 mo) <sup>-1</sup>
Earthquake detection (Univ. of Alaska)	Seismograph	Continuous, check site 1 wk <sup>-1</sup>

TABLE 1.4. Summary of Measurement Programs at BRW in 1993—Continued

Program	Instrument	Sampling Frequency
<i>Cooperative Programs - Continued</i>		
$^{13}\text{CH}_4$ ( $^{13}\text{C}/^{12}\text{C}$ ) (Univ. of Washington)	35-L stainless steel flasks	1 (2 wk) <sup>-1</sup>
UV monitor (NSF)	UV spectrometer	1 scan per 0.5 hour
Magnetic fields (NAVSWC)	$^3\text{He}$ sensors	Continuous
Sound Source (DOE)	RASS	1 hr <sup>-1</sup>
Ice Buoys (NOS)	Ice buoys	Continuous
O <sub>2</sub> in air (Univ. of Rhode Island)	3-L glass flasks	1 pair (2 wk) <sup>-1</sup>

**Methane.** For the past few years BRW CH<sub>4</sub> data has shown a decrease in the growth rate. During late 1992 and early 1993 the growth rate actually exhibited a negative trend. This trend continued during 1993. Yearly cycles are seen with mixing ratios of between 1750 ppbv and 1950 ppbv.

During July the Carle GC electrometer board failed and was replaced. The system ran for the rest of the year with no problems.

**Carbon Monoxide.** A Trace Analytical GC has collected CO data at BRW since the fall of 1991. Like CH<sub>4</sub>, the growth for CO has shown a marked decrease. Flask data are available from 1990 on. Annual average mixing ratios of approximately 150 ppbv are measured with data ranging between 250 ppbv and 75 ppbv.

In January the CO program was modified to run with three calibration gases to correct for any non-linearity in the detector. The Hg lamp was replaced in July after it dropped below acceptable output limits.

**Flask Samples.** The Carbon Cycle Division (CCD) flask samples were collected with few problems during 1993. Data concerning the CCD flasks can be found in section 2.1.6. Whole air collected using the various glass flasks is analyzed for CO, CH<sub>4</sub>, and CO<sub>2</sub>.

A problem was discovered in the data when MAKs flask data are compared with CMDL 3-L data. The problem was discovered in 1992 and is still under investigation by CMDL personnel in Boulder.

### Meteorology

September ushered in an ice storm that coated the streets of Barrow with ice. Temperatures remained cold enough that there was no melting. A storm in October brought enough snow to allow station personnel to ski to work but within 2 days was blown away by the high winds and the ice was uncovered.

Problems were corrected with the TSL hygro-thermometer. The instrument performs an auto-balance, which cleans the mirror, and should return to a zero value. The dewpoint assembly was replaced in May and no further problems occurred.

### CAMS

CAMS ran without any significant problems for the entire year. However, plans are being made by most groups in Boulder for the next generation data acquisition system. CAMS is approaching the end of its useful life and alternative collection schemes must be implemented.

### Ozone

**Surface Ozone.** Surface ozone is measured with a Dasibi ozone monitor. The Dasibi measures continuously and ran all year with only routine cleaning of the absorption tubes. Data continues to show trends of past years; i.e., springtime lows and highs during the dark winter months.

**Dobson.** Dobson 91 is the instrument in BRW and observations are made from February until October. A semi-automated data acquisition system was added to the Dobson in May and has proven to be quite useful. Station personnel can now see real time ozone amounts as measured by the Dobson in Dobson Units (milli-atmo-centimeters).

### Halocarbons and Nitrous Oxide

**Gas Chromatographs.** System lock-ups continued to plague the system during 1993. The only cure was to cycle the power. Batteries in the UPS for the DAS were found to be old enough that two of the four would no longer hold sufficient charge to run the system in the event of a power outage. The batteries were replaced. A suspected bad disk drive was replaced in August when several disks were found to be devoid of data. Leaks in the pneumatic lines caused the most problems and occurred on several occasions. The detector for channel B was replaced late in the year.

**Flask Samples.** Flask samples were collected as available and scheduled. Data concerning the flasks can be found in the Nitrous Oxide and Halocarbons section (5.1.4).

### Cooperative Projects

Only programs with problems or unusual occurrences are mentioned in this section.

**University of Rhode Island.** A series of flask samples were collected during 1993 to test the feasibility of collecting whole air for analysis of O<sub>2</sub>/N<sub>2</sub> and CO<sub>2</sub>. Data collected by measuring O<sub>2</sub> can yield vital information regarding the fate of fossil fuel

CO<sub>2</sub> as well as ocean fertility. The test was successful and a regular schedule of sample collecting has begun.

**DOE/EML.** Air filters collected at BRW were sent to DOE/EML on a weekly basis for analysis because of an explosion at a nuclear fuel processing plant near Tomsk in the former Soviet Union. A signal was detected in Barrow.

**DOE/Sandia National Laboratory.** Preliminary site choice was made for the DOE CART/ARM site near Barrow. In cooperation with the North Slope Borough, Department of Wildlife Management, a 12-18 month test of the sound source for the RASS began in July. The test will show if there are any effects on local wildlife because of the high level of sound generated.

**USDA/SCS.** In July a gust of wind destroyed one of the longest running cooperative programs at the BRW Observatory. The Wyoming rain gage was knocked down when a gust of wind measuring 30 m s<sup>-1</sup> (66 mph) hit it during July. The warm summer temperatures caused a deeper melt than normal and the

anchor bolts gave when the wind hit. There are no plans to fix the gage.

**USGS.** BRW personnel have assumed the duties of calibration for the USGS Magnetic Observatory. A new MOA with USGS was negotiated (see Section 6.0, page 140). The Barrow Magnetic Observatory is one of thirteen observatories: three in Alaska, seven in the contiguous U.S., and one each in Hawaii, Puerto Rico, and Guam. Six sets of absolute measurements are made once each month to determine the horizontal and vertical intensity and the declination. These numbers are then used to calibrate the continuous measuring instruments at the site.

**NOAA/Navy Joint Ice Center.** Several ice buoys were installed for a long-term calibration study. There is a question about the long-term-stability of the sensors and BRW was chosen as the most suitable location to test the sensors. Data are collected on a laptop computer and downloaded by personnel from the National Ocean Service in Silver Spring, Maryland.